Chapter 8

Implications of the Google's US 8,996,429 B1 Patent in Cloud Robotics-Based Therapeutic Researches

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Additional information is available at the end of the chapter

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Abstract

Intended for being informative to both legal and engineer communities, this chapter raises awareness on the implications of recent patents in the field of human-robot interaction (HRI) studies. Google patented the use of cloud robotics to create robot personality(-ies). The broad claims of the patent could hamper many HRI research projects in the field. One of the possible frustrated research lines is related to robotic therapies because the personalization of the robot accelerates the process of engagement, which is extremely beneficial for robotic cognitive therapies. This chapter presents, therefore, the scientific examination, description, and comparison of the Tufts University CEEO project "Data Analysis and Collection through Robotic Companions and LEGO® Engineering with Children on the Autism Spectrum project" and the US 8,996,429 B1 Patent on the Methods and Systems for Robot Personality Development of Google. Some remarks on ethical implications of the patent will close the chapter and open the discussion to both communities.

Keywords: cognitive therapeutic robots, cloud robotics, Google patent, personality, personalization, ASD research, ethical implications

1. Introduction

Compared to neurologically typical children, children and adolescents under the autistic spectrum disorder (ASD) have persistent deficits in social communication and social interaction across multiple contexts [1]. They normally have deficits in social-emotional reciprocity and difficulties in developing, maintaining and understanding relationships [2]. Helping these children to deal with a multitude of simultaneous sensory inputs and peer-mediated approaches through social play interventions has been proven to be effective [3]. The problem with traditional interventions, however, is that researchers are confronted with the task to investigate the complex relationship between the acquisition of communication skills, social-emotional factors and types of transactional support that predict better outcomes for children with ASD [4]. Moreover, this is greatly challenged by the fact that, albeit children with ASD have comparable developmental difficulties, there are many differences among children with ASD [5].

A therapy to be effective, therefore, not only should address the predominant core characteristics of ASD, but also be individualized to meet the needs of each participant [4]. Robots help bridge this existing gap because they can adapt easily to each individual's needs, they are predictive and repetitive and also very engaging [6, 7]. In fact, not only the use of robots has been found to be remarkable in cognitive rehabilitation therapies, but also the actual process of building them encourages social and cooperative skills, which can be very positive for autistic children [8–10].

The Tufts University CEEO project "Data Analysis and Collection through Robotic Companions and LEGO® Engineering with Children on the Autism Spectrum" measures the effect of LEGO® engineering and its collaborative nature on the development of social skills in children and adolescents with ASD. Furthermore, in order to contribute to solve the lack of quantitative data in projects concerning robots and autism [11], the project uses logger robots connected to a cloud system combined with a traditional recording and coding system to allow the data collection. The cloud system will also help control the behavior of the robots, which will participate actively in the classroom playing the role of master to help students work together and achieve classroom goals.

On March 31, 2015, Google was awarded a patent regarding methods and systems for robot personality development. The patent covers those robots that can be customizable with personality attributes and related capabilities drawn from cloud computing capacities [12]. According to the patent, these attributes can be in audio or visual format and can be derived from the human-robot interaction, the surroundings or the circumstances. Moreover, Google aims at the transferability of these robot personalities. For at least 20 years, Google will have the exclusive right to exploit the content of the patent.

The correlation between both the CEEO project and the Google patent lies on the fact that, in order to have success on the therapy, the children need to be engaged and this engagement comes, most of the times, from the robot personalization. Although the engagement between the user and the robot is not customization-dependent [13], it is found that the personalization of it accelerates the process of engagement. Indeed, because engagement drives learning, there are a lot of educational and therapeutic projects that personalize robots to promote this engagement [14, 15]. The trickiest part lies on the fact that this personalization is done through the cloud system, as it happens with the CEEO project.

Although patents cannot frustrate the primary object of the patent laws, i.e., to promote innovation [16], the broad method patented by Google could block all those projects that use robots and cloud services in the same line. This is the *raison d'être* of this article: by explaining the similarities between the CEEO project (Section 3) and the Google patent (Section 4), this book chapter will explain why the Google patent could frustrate ongoing projects in education—for neurotypical children and for nonneurotypical children [17, 18]. Basic concepts such as cloud, patent, robot system or personalization will introduce the discussion in Section II, as this chapter aims at being informative to both the legal and the technical communities. Some remarks on how this could be avoided will be shortly presented in Section 5 too.

2. Definitions

In order to fully understand the controversial situation about how Google's patent US 8,996,429 B1 can interfere with current and future research based on cloud robotic systems, we need to define the four key factors involved: what is cloud robotics, what is a robotic system, what does personality mean for robots and what are patents.

2.1. Cloud robotics

In 1997, Ibana was the first to give a premature explanation of cloud robotics. He explained, "a remote-brained robot does not bring its own brain with the body. It leaves the brain in the mother environment, by which we mean the environment in which the brain's software is developed, and talks with it by wireless links" [19].

This is based on what later on would be understood for *cloud computing*. Coined in 1996, and extended in 2006 [20], National Institute of Standards and Technology (NIST) defined cloud computing in 2011 as a "model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources […] that can be rapidly provisioned and released with minimal management effort or service provider interaction" [21].

Similar to the idea of Ibana, in 2010, Kuffner saw also the advantages of using cloud capacities for robots: it could provide a shared knowledge database, offload heavy computing tasks to the cloud and create a reusable library of skills or behaviors that map to perceived complex situations [22]. In the same year, others were also announcing cloud-computing frameworks for service robotics [23]. Soon, the concept of *cloud robotics* was consolidated, and nowadays, it refers to "any robot or automation system that relies on data or code from a network to support its operation, i.e., where not all sensing, computation and memory is integrated into a single standalone system" [24].

Even if a recent concept, most of roboticists having to process large quantities of data with their robot can choose to use cloud robotic platforms because all the constraints related to the existing framework whatsoever its nature (resources, information or communication) are somehow mitigated [25]. In fact, Inaba already conceived something similar called "remote-brained robot" [19], and even the Roboearth project introduced a World Wide Web for robots in 2011. In this project, it was argued that in the near future robots would need to reliably perform tasks beyond their explicitly preprogrammed behaviors and quickly adapt to the unstructured and variable nature of tasks, something unlikely without a cloud platform [26].

Waibel et al. proved that the use of a cloud system could create an environment where knowledge and information could be shared, allowing a better robot performance, and where robots could use this shared knowledge independently of their architecture. In addition, they expounded that it may also offer other benefits by allowing component reuse across different systems and developers, human knowledge about the component usage, robustness and efficiency. In the following years, several researches have adopted this technology to foster individual child partnership in medical facilities, for robot companions for elderly care or for education purposes [17, 27, 28].

2.2. Robot and robotic system

Although Čapek brothers' intention was not to define "robots," because they basically just ushered the word into existence [29], thanks to their 1922 play R.U.R. [30], Oxford dictionary today defines robots as "machines capable of carrying out complex series of actions automatically, especially one programmable by a computer." On its side, an although stating that the question was too meaningless to deserve discussion, Alan Turing in 1950 already believed that at the end of twentieth century people could talk about machines thinking without being contradicted [31].

Nowadays, and not far away from this vision, robots are considered machines, situated in the world, that sense, think and act [32]. Although it has been argued that a robot does not *think* but rather processes the information and weights potential outcomes [33], it is also true that the word "think" cannot be interpreted in its common meaning [34]. In fact, the machine decision-making process normally includes (1) data acquisition, perception through sensors (infrared, radar, stereovision, optical encoders, etc.) and filtering/fusing information; (2) navigation, localization and decision-making (path planning, obstacle avoidance and machine learning); and (3) locomotion, kinematics and motor control in order to act (in various forms: manipulating or moving) [35].

A robot therefore can sense its environment, has the capacity to process the information and is organized to act directly upon its environment [36]. *Mobility*, therefore, is an important aspect when defining robots. Consistently, the industry defines a robot as an "actuated mechanism programmable in two or more axes with a degree of autonomy moving within its environment, to perform intended tasks" [37].

A *robotic system* relates to all the systems that, in interaction with each other and the environment, allow the robot to actuate. In the case of the CEEO project, and at the physical level, the technology involved in the pilots is a robot companion for each group of learners, a wearable device per learner, a touchable device to interact with the robot, and a laptop to implement part of the sensors' signal processing. At the network level, the network electronics needed to provide the cloud services to run all the integrated system. At the application level, information about the performance of the child is stored. Cameras hidden in the room also provide information regarding the environment.

2.3. Personality of the robot

Personality refers to the "dynamic integration of the totality of a person's subjective experience and behavior patterns, including both (1) conscious, concrete, and habitual behaviors, experiences of self and of the surrounding world, conscious, explicit psychic thinking, and habitual desires and fears and (2) unconscious behavior patterns, experiences and views, and intentional states" [38]. UNESCO defines behavior as the way in which an individual behaves or acts, even if there is not an accepted definition of behavior [39, 40]. In plain language, personality is what an individual is, and behavior is what an individual does. What do personality and behavior mean with regard to robots?

Industrial robots did not have interaction with humans—they were normally fenced off to protect humans. The concept of personality and behavior of robots began with the inception of social robots. Already in 1999, Breazeal and Scassellatti were working on robots that could interact socially with humans [41]. Miwa et al. highlighted in 2001 that the personality of the robot was especially important in achieving smooth and effective communication with humans [42]. In 2003, Fong et al. presented a review of the common features of social robots [43]. According to them, social robots expressed/perceived emotions, communicated in high-level dialogue, learned/recognized models of other agents, established/maintained social relationships, used natural cues—such as gaze or gestures—and exhibited distinctive personality and character and that might learn/develop social competencies. They agreed that social robots could be very different, since those robots uniquely engage people in social interactions, to robots that were programmed to fulfill social norms and carry out tasks in environments habited by humans. They also mentioned that some of these robots use deep models of human interaction to proactively encourage social interaction, while others would rely on humans to attribute mental states and emotions to the robot. To this, and similar to the idea that the complexity of the behavior of an ant is more a reflection of the complexity of its environment than its own internal complexity (speculated that the same may be true for humans) [44], the environment can influence the behavior of a robot directly, through sensors, or indirectly by the action of the user.

In 2006, a large study on the personality of social interactive robots and human perceptions was conducted [45]. The participants of the study perceived the robot's personality although its nature was nonhuman. This has had an impact on human-robot interaction studies as the personalization of the robot—meaning adapting its personality to the user—is widely accepted to play a major role in accelerating the engagement with the robot, partly because it motivates the user [13, 15].

2.4. Patents

The United States was the last country to adopt a first-to-invent patent system. In 2011, however, following other examples like EP, JP and CN, the United State Congress passed the Leahy-Smith America Invents Act (AIA), which involved the abolishment of the long tradition first-to-invent system and the adoption of the first-to-file system [46]. After the AIA entered into force in 2013, the Office Patent would grant the patent to whoever filed the application first regardless of its invention date (with some exceptions and grant periods previewed in 35 USC §102) [47].

§101 of the above-mentioned *corpus iuris* expounds that "whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent […]." In other words, a patent is a "document, issued, upon application, by a government office […] which describes an invention and creates a legal situation in which the patented invention can normally be only exploited […] with the authorization of the owner of the patent" [48].

Not all inventions can be patented though. Actually, inventions need to meet some general conditions to be patentable. An invention will be patentable if it:

- has a patentable subject matter (i.e., it falls under the definition of 35 USC §101),
- is novel (i.e., it is something new according to 35 USC §102), and
- is nonobvious (i.e., nonobvious for those who have an ordinary skill in the art, 35 USC §103).

Once granted, the patent holder will have a period of time to exploit it exclusively. Article 47 of the Patent Cooperation Treaty leaves the contracting parties to decide time limits. In United States, time limit for patent exploitation is at least 20 years, unless failure on the payment of the maintenance fee (vid. 35 USC §41.c.1).

3. Robotic therapies: the case of the robot companions and LEGO® engineering

LEGO®-based robots have been proved to be an effective tool to use in education, not only for undergraduates, but actually for all ages [49, 50]. LEGO engineering creates a context where social and problem-solving skills meet each other. This has been found extremely positive for children with neurodevelopmental disorders [51–53]. It seems that making the robot behavior depend on user actions is positive in robot therapies because it involves the motivation of the user [54].

The CEEO project aims at observing and measuring the engineering skills and processes of children with ASD using this type of robots. The project aims at collecting quantitative data to compare the results with those of typically developing children. The main idea is to look for examples where students with ASD can be role models for typically developing students, both in how they develop and in how they solve engineering problems.

Implementing this methodology with high dysfunctional children, nevertheless, would require a lower ration of children than therapists, needless to say that the collection of information from the session would be very hard to obtain. To solve these issues, the CEEO project introduces a cloud-based robotic system that includes (**Figure 1**): social robots that can work as mediators, companions, which are connected online with an expert system developed from previous experiences and human experts in the field of ASD, as well as external sensors such as cameras or user interfaces. This way two of the main tenets of practice in intervention approaches for autistic children are met [4]: individualization of the therapy to match children's current developmental level on his or her profile, because the exercises are done in accordance with the child's performance level, and the address of the predominant core characteristics of ASD, because all the exercises are focused on social-emotional reciprocity, verbal communication and cognitive processing similar to previous studies of the same researchers [55].

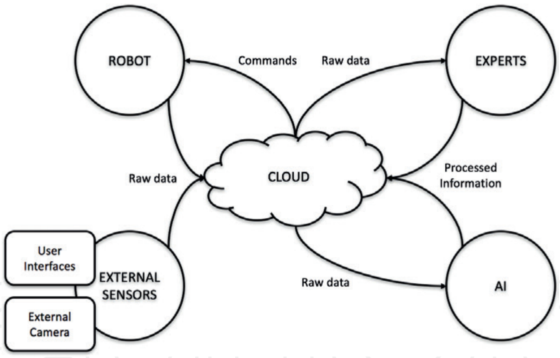

Figure 1. Robot and Cloud Interaction Tufts-CEEO's project.

The robot companion has the role of a helper, a social mediator and a facilitator and reminds children of the time schedule. They interact with the children through gestures and expressions, lights, sounds and speech. The robot companions are controlled by the cloud system. Decisions are based on (1) the interface used by the conductor of the session/teacher (highest priority), (2) the web-based interface the learners use to communicate with the robot and (3) a probabilistic decision model based on past events and finite-state machines. The transition between states is produced by time schedule, as well as from the input from the children, or the teacher/instructor of the class.

Through the expertise acquired by the cloud system, it is expected that: (1) the robot can identify stressful situations and act as a companion to help cope and provide tailored strategies to the individual child throughout the social skills treatment plan; (2) the robot can work as a data logger that collects quantitative data, to understand how children with ASD deal with social situations and what strategies they use to solve problems; and (3) the complexity of the therapy is reduced in cost and time terms.

The cloud architecture helps maximize the effectiveness of the shared resources of the robotic system that is connected to a network [56]. In particular, the cloud-based infrastructure allows:

- The robots to upload video during the sessions. The video is stored on the server database. There is a camera on the ceiling of the room that is also sending the video recordings to the server database.
- The web-based child-to-robot interface to send commands to the cloud. The child uses it to interact with the robot companion.
- The web-based teacher/conductor interface to send commands to the cloud. The teacher uses to interact with the robot companion and also sends commands to the cloud.
- The robot companion to receive commands from the cloud that teleoperate their behavior.
- The robot companion to behave upon the information of the experts on ASD and the therapists—to detect stressful situations for instance.
- Researchers to login to the cloud system to watch and code the video in order to provide human feedback to the artificial intelligent (AI) system.

- The information from the questionnaires to be stored in the server database and to be seen by the researchers.
- The process of the acquired information to create models and descriptors of the interaction state of the children.

Robots in the project have a preprogrammed personality because it is expected to interact with the children on a high-level dialogue and use natural and social cues [43]. For emotion recognition exercises, the companion robot is expected to express emotions so that the child can perceive them as such. The robot behaves according to this by-default personality.

There is evidence in the literature that a good match between a patient and a coach produces better results of therapy or treatment [57]. And because algorithms that learn how to customize certain objects to customize personal characteristics have existed now for more than 10 years [58], the robot, over time, changes its behavior. The personalization of the robot consists on building loyalty between the robot and the child through matching each other's needs, through the construction of a meaningful one-to-one relationship.

In the current project, the personalization of the robot is based on information the researchers get from the parents (through questionnaires). Sometimes the robot's personality changes according to the child's likes and dislikes. This information is drawn from the cloud. Only by understanding the needs of each individual, and by satisfying a goal that efficiently and knowledgeably addresses each individual's need in a given context, this can happen.

4. Google's patent: methods and systems for robot personality development

Google was granted a patent for methods and systems for robot personality development. This disclosure patented a process to create robots permeated with personality or personalities, drawn from cloud computing capacities, and capable of interact with users [12].

The scope of Google's patent is to describe the techniques and processes for user-robot interaction (URI) to engender personality for the robot. Google defines personality as the "personification in the sense of human characteristics or qualities attributed to a non-human thing […] such that the robot interface is customized to provide a desired personality for the robot" [12].

The robot collects mass information from the user and its surroundings and tailors a personality to interact upon with the user. The ultimate goal is to interact with the user more personally. The patent describes what is the method that will use to collect the information to forge the personality of the robot, i.e., from different sources and by the processing of all this information in the cloud. Some examples of raw data and devices to which the robot might have access are briefly enounced in the patent:

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- The robot might have information from the user himself/herself, e.g., all the possible information relating to: calendar, email, text messages (or other electronic correspondence), call log, recently accessed documents on a computer, Internet browser history and so on;

- The robot might have access to the user's devices, which could include: a computer, laptop, mobile phone, PDA, tablet, cellular or other mobile computing devices. Any other television or cloud computing devices, or any device with capacity to access the cloud, will also be considered as a user's device;

- The robot's sensors could collect information about the environment such as: the location, time of the day or weather, and even information about nearby objects, the language the user uses or information that can be available through the interaction with other robots;

- The robot might have access to the information stored in online profiles the user might have on the Internet, e.g., social network sites.

The robot might send all this unstructured data to the cloud and receive back processed data to customize the personality of the robot. As we can see in **Figure 2**, the interaction could not only be between the user and the robot, but also between the robot and other sources, such as other sensors, other robots or the Internet itself. These latter interactions could be done directly, e.g., between robots, or indirectly, through the cloud. Indeed, it will be able to share information with other cloud computing devices.

Google's patent includes the robot's estimation of the user's mood. The idea is to evoke positive responses when the user feels sad, either computationally or locally if a mood recognition database has been provided to the robot [12]. In this model, moreover, Google envisages the possibility of transferring the robot personality, through the cloud, to other robots.

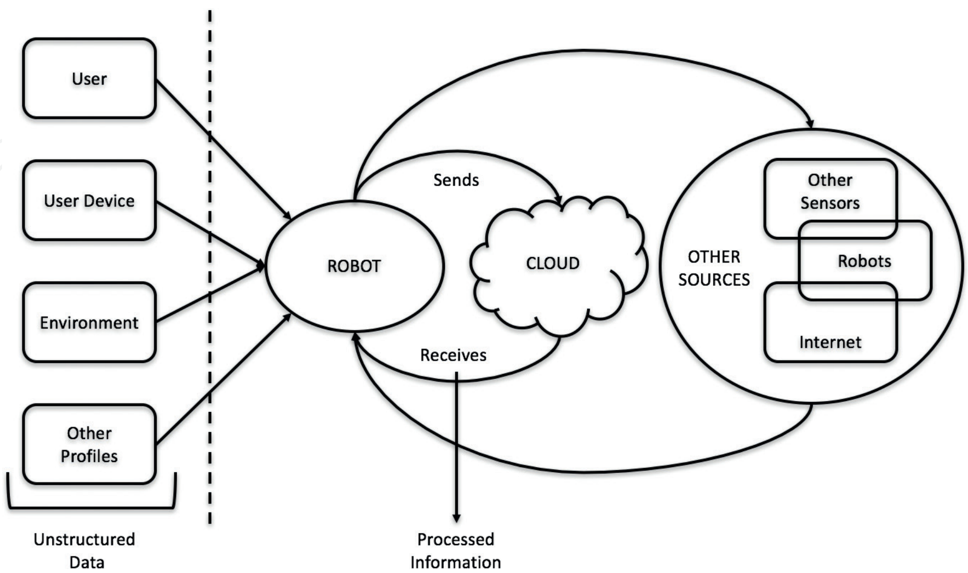

Figure 2. Robot and Cloud Interaction. Google's US 8,996,429 B1 Patent.

5. Adequacy of the patent to patent law

US 8,996,429 B1 Google Patent is called into question below. Using the Alice US Supreme Court judgment as a base, the patent is questioned about its adequacy to the conditions for patentability established in title 35 United States Code [59]. As established in the case Verdegaal Bros v. Union Oil Co. of California, we will try to argue if each and every element of the claim has been addressed previously, because a claim is anticipated only if each element is found, either expressly or inherently described, in a single prior art reference [60].

5.1. Patentable subject matter

The definition set in 35 USC §101 suggests a very important exception: laws of nature, natural phenomena and abstract ideas are not patentable [16]. Patents are the basic tools for scientific and technological work, and they tend to promote innovation, not to impede it, and that is why these aspects are not patentable [61]. Google, nonetheless, patented a broad method—the creation of a robot personality using cloud robotics—that might impede innovation.

The Supreme Court, however, states that an invention is not directly invalid because it is an abstract concept, but it will remain eligible for a patent when those concepts can be applied to a new and useful end [62]. As described in the next subsection, Google patents a well-known method to process all the collected information for the creation of the personality of the robot, which is not something new: all social robots have a default personality [43]. Breazeal stated that the physical appearance, the robot manners of movement and its manner of expression convey personality traits to the person who interacts with [63]. According to her, this fundamentally influences the manner in which people engage the robot. From 1997 to 2000, they already developed Kismet with (infant-level) social competences that were already running in fifteen computers.

The Court adds in the Mayo judgment that, in order to be eligible for a patent, the application of the law-of-nature, natural-phenomenon and abstract-idea concepts must be determined to be an inventive concept [61]. Detecting the user's mood through sensors, nevertheless, and using cloud-computing capabilities to process all the information and modify thereupon the personality of the robot is not an inventive concept [27, 64, 65].

5.2. New (novel)

35 USC §102 describes generally speaking that only new inventions can be patented. Google describes the idea of using cloud-computing capabilities to collect mass data, reduce/offload the intensive workloads from the onboard resources on robots, to create a robot personality and to transfer this personality from one robot to another one. All these procedures/methods/concepts have been done before:

- Regarding workload reduction in robots, Ibana already envisaged the idea of a "remote-brained robot" although the term "cloud computing" was not yet used in 1993 [19]. Softbank has marketed the use of cloud AI and an emotion engine for a robot already as a product [66].

- The idea of creating a robot that could interact with information from the physical world dates from 1993 too [67]. Brooks and Stein wanted to design a robot that could "learn new behaviors under human feedback such as human manual guidance and vocal approval."
- The use of sensors to collect grounded and real information from the user is not new [27].
- Transferring the collected information to a single collection point, the possibility to share it among robots (robots talking to their neighbors) is not new. Winfield addressed largely the way collective robots work [68].
- Building a personality in a robot is not new either. Breazeal and Fong et al. already stated in the early 2000 that socially interactive robots exhibit distinctive personality. Studies regarding robot personality and user's perception have been carried out during 2006 [45].
- In 2008, moreover, Wowwee® released Mr. Personality™, a robot that had personality. His user manual states that Mr Personality™ comes with a default persona (Max and Simon), similar as what Google describes on its patent, and the user can use software to download new personalities via Internet [69]. Multiple personalities, therefore, are not a new concept either.
- Transferrable personalities are neither a new concept. Page 35 of the user manual of the Wowwee® robot states that: "to transfer personalities from your computer to your robot click on MyComputer […]."

Both the method and the hardware have been already addressed in previous literature and products. Furthermore, the construction of personality for robots to interact with humans is one of the very basic foundations of human-robot interaction studies.

5.3. Be nonobvious (inventive step)

35 USC §103 strictly says "a patent may not be obtained […] if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains […]."

The problem is that cloud robotics is a logical step toward solving the problems networked robots are encountering [26]. Indeed, the use of cloud robotics mitigates mostly all the constraints related to their existing framework [25]. The way Google expounds it reminds to what happened in Bilski v. Kappos [70], as if the whole method was "taught in any introductory [in this case computer science] class."

Actually, Google patents some well-known procedures to collect data from different sources, to use this data to personalize the robot [58]. The jurisprudence of US Supreme Court is clear in this respect: "simply appending conventional steps, specified at a high level of generality, to a method already 'well known in the art' is not 'enough' to supply the 'inventive concept' needed to make this transformation" [59].

Indeed, similar to what the Alice judgment stated, "the functions performed by the computer at each step of the process are purely conventional and considered as an ordered combination the computer components of petitioner's method add nothing that is not already present when the steps are considered separately" [59], one could understand that if instead of *computer* the wording read *robot* then the Court would be referring to the case we are addressing.

6. Other remarks: ethical questions arisen from the patent

The Google patent describes what is the method to create the personality of the robot and uses examples to represent its possibilities. These examples raise several ethical questions. Here we will mention: (1) the safety of the user (produced by reinforcing learning); (2) the possibility to talk to dead people; and (3) the delegation of autonomy (which could lead to robot responsible scenarios).

1. The patent of Google states:

> At block 826, the method 820 includes modifying the default user-profile to incorporate the estimated personality so as to provide a modified persona. This can be a transitory modification or something more permanent. For example, the robot may prepare food for the user using peanut oil. The user, who may be allergic to peanut-based foods, may eat the meal and have an allergic reaction. The user may further scold the robot for cooking the meal with peanut oil. Scolding may be considered a negative feedback response where the user is directing a negative reaction toward the robot for an action that the robot committed. On the other hand, a positive feedback response may be a positive reaction toward the robot for an action that the robot committed. In this example above, the robot may permanently modify information in the user-profile to include the user's allergic reaction to peanut and avoid anything to do with peanuts in the future.

In this paragraph, the patent argues that the robot can estimate the user's mood depending on the reactions to a certain scenarios. This estimation nevertheless can lead to a serious critical risk scenario. Food-induced anaphylaxis affects multiple organ systems and hospitalization due to the fact that it has increased over these years [71, 72]. Even if the patent refers to a particular scenario, and wants to emphasize the fact that depending on the reactions the robot will be able to discover whether the user might like one thing or another thing (as a kind of reinforce learning), this constitutes an overtaking decision-making process from the robot. Independently of whether a robot can or cannot learn from the experience of the user, the actions autonomously taken by the robot should never endanger the safety of the user. Even if the robot might be in a learning process, there are several protective measures that should be embedded to avoid any unfortunate scenario. If the robot prepares the meal with peanut oil, the person suffers anaphylaxis, and then, the system fails to call an ambulance; then, not only the company would be responsible for an unwilling scenario, it will be responsible for the death of a person.

As suggested by Amodei et al., "systems that simply output a recommendation to human users, such as speech systems, typically have relatively limited potential to cause harm. By contrast, systems that exert direct control over the world, such as machines controlling industrial processes, can cause harms in a way that humans cannot necessarily correct or oversee" [73]. This should be carefully addressed, especially in the light of what the patent describes "the robot may respond to the negative reinforcement response by continuing to perform other tasks until a positive reinforcement response is received."

2. As written on the patent, "the robot may be programmed to take on the personality of real-world people […] or a deceased loved one." The patent suggests that with their method, and because there will be no deletion of the data, there will be the possibility to speak with the personality created from a person that could be dead or alive. This is the first time Google mentions death. Up to now, no provision regarding death can be found in its terms and conditions [74]. Postmortem privacy has been addressed by other platforms like Facebook [75]. In Europe, the 679/2016 General Data Protection Regulation does not address this topic, even if there are some EU member states that have decided to cope with it [76]. The Article 29 Working Party said in an opinion, "information relating to dead individuals is therefore not to be considered as personal data" even if "may still indirectly receive some protection" [77]. In the light of the intentions of the Google patent, and lacking an express provision in this regard, it will be extremely important to answer the question whether this function of the (possible future) robot of Google is ethical or not, and how this should be modeled.

3. To close, Google aims the robot to take over in several situations. As an example the patent states, "the robot may then adopt a persona of the user's mother, and indicate 'it is time to clean out the refrigerator, honey'" [12]. Delegation of authority in the human decision-making process—to a robot in this case—nevertheless, calls for special attention. In sociology it is said that one actor has authority over another when the first holds the right to direct the actions of the second [78]. Linked to it, if robots have agenthood (an hypernym to describe that not only humans exhibit morally responsible behavior) [79]) as the European Parliament suggests on its latest resolution [80], then it could possibly mean that the robot is held responsible for its acts—which may lead to held Google responsible for them as it occurs with the autonomous cars.

To all this, there are currently no legally binding frameworks or guidelines on the creation of robotic technology that could approach ethical implications. The only corpus addressing this issue is "BS 8611: Robots and robotic devices—Guide to the ethical design and application of robots and robotic systems," which was recently published. BS 8611 has identified broad range of ethical hazards and their mitigation including societal, application, commercial/financial and environmental risks. Concerning societal hazards, the concepts of deception, privacy, confidentiality, addiction, loss of trust and employment are also addressed.

However, it is uncertain to what extent social robot creators should incorporate features beyond mere technical aspects in their design process—as the BS 8611:2016 standard suggests. Standards are good instruments to deal with complex, new and international issues; however, they do not have binding force. The draft report of the European Parliament is a *lege ferenda* (a proposal for a future law) and has been approved by the European Commission in January 2017. If this ends up into a binding corpus iuris, then an ethical framework for those who design robots will have to apply regardless of any patent.

7. Conclusion

Google secures the patent adding the following statement: "it should be understood that arrangements described herein are for purposes of example only. As such those skilled in art will appreciate that other arrangements and other elements […] can be used instead." This basically means that no matter what machines or functions are used, if they are used for all the purposes described in the patent, they will under the patent's scope. This does not promote innovation according to the Mayo judgment, especially knowing that Google is not actually developing the technology but focusing on industrial robots, as Darling already mentioned in [81].

Many research projects, which could prove beneficial to children with autism, could be hampered by restrictions due to the broad claims of the Google patent. There exists, however, various administrative and judicial avenues to review the scope and validity of the patent claims. In September 2012, AIA incorporated the Inter Partes Review (IPR). The IPR is a procedure to challenge the validity of patent claims based on patent and on printed publications. As stated by the PLI Patent Bar Review, the IPR proceedings are available for any patent whether issued before, on or after September 16, 2012. The transitional program for covered business method patents applies to any covered business patent in the same terms. Furthermore, if there was an action, the Supreme Court of US could decide whether the patent was correctly granted or not.

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